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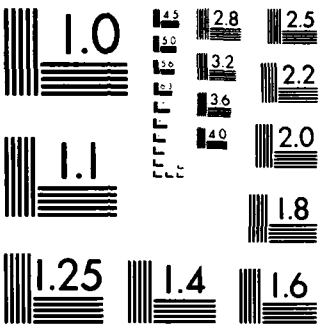

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Landing Control Central
Air-Ground Communication
Ground Control Approach

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This Test Operations Procedure (TOP) describes test methods and techniques for evaluating Landing Control Centrals and their suitability for use in the intended tactical environment. Procedures are included for measuring the antenna patterns of the multiple antenna installation, the communication ranges, and the radar and IFF acquisition ranges.

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US ARMY TEST AND EVALUATION COMMAND
TEST OPERATIONS PROCEDURE

AMSTE-RP-702-102 1 November 1984

*Test Operations Procedure 6-2-160
AD No.

LANDING CONTROL CENTRALS

1. SCOPE

This Test Operations Procedure (TOP) describes test methods and techniques for measuring and evaluating the technical performance and characteristics of landing control centrals relative to requirement documents and specifications.

Because of the state-of-the-art advances being incorporated into new equipment and systems, this TOP does not provide detailed test procedures for a specific test item. These procedures may be modified to accommodate the characteristics of the specific item being tested.

This TOP provides procedures for testing the overall performance of the Landing Control Central. It does not include procedures for testing the individual equipment or systems that may have been incorporated into the Landing Control Central.

*This TOP supercedes MTP 6-2-160, 18 Aug 1969.

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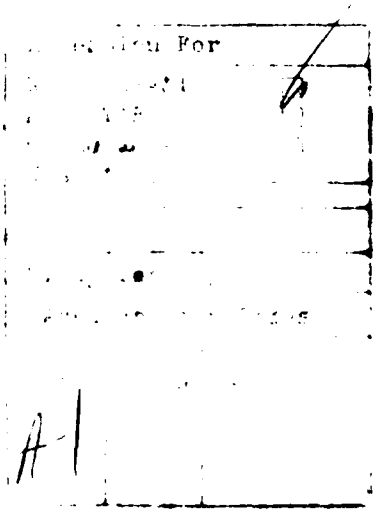

2. FACILITIES AND INSTRUMENTATION

2.1 Facilities

a. A range and flight test facility with:

(1) Adequate land area with controlled air traffic and level flight path capability out to 100 miles (161 km) [150 miles (241 km) preferred] at altitudes of 2000 feet (609.6 m) and/or 5000 feet (1524 m) above nominal terrain.

(2) Tracking radar, Global Positioning System (GPS) or other space position plotting and recording equipment for the flight path area of paragraph (1) above.

(3) Ground control station.

(4) Test control ground-to-ground and air-to-ground communications.

(5) Common range timing.

(6) Meteorological support facility.

b. An antenna pattern measurement facility.

2.2 Instrumentation

The following instrumentation are required but not limited to in support of this TOP:

a. Airborne recorder with common range clock time markers.

b. Ground recorders with common range clock time markers.

c. Photographic and/or video recorders.

d. Frequency meters/counters.

2.3 Characteristics/Requirements

The characteristics of required instrumentation are determined by the performance specifications of the individual equipment or systems. All instrumentation must have an accuracy greater than the equipment it is testing. All instrumentation shall be calibrated by approved methods and instrumentation traceable to the National Bureau of Standards. The facilities and instrumentation indicated above can provide the necessary characteristics required to perform the subtest indicated in this TOP.

3. PREPARATION FOR TEST

a. Review available test design plan (TDP) and/or detailed test plan (DTP).

b. Establish and/or continually maintain a readily accessible project log and project file.

c. Review local installation project office handbook, standing operating procedures for preparing test plans, conducting tests, preparing reports, reporting to the Test Resources Management System (TRMS) and budgeting.

d. Acquire and review all descriptive, instructional, and specification materiel on the test items issued by Government and contractor(s) for checking the test plan's subtest objectives, criteria, facility(ies), and instrumentation requirements.

e. Determine the scheduled availability of the test item.

f. Ensure availability of appropriate facilities and coordinate the test support requirements including personnel, equipment, maintenance, spare parts and instrumentation.

g. Review the detailed test plan.

h. Record as a minimum the following data:

(1) Nomenclature, serial number(s), manufacturer's name, and function of the item(s) under test.

(2) Nomenclature, serial number, accuracy tolerance, calibration requirements, and last calibration data to include date of test equipment selected for the tests.

(3) Damages to the test item(s) incurred during transit and/or manufacturing defects.

(4) Test item photographs.

i. Establish instrumentation or measurement system mean error and standard deviation of error from the manufacturer's specifications. Ensure that instruments have been recently calibrated.

j. Determine test item sample size. (TOP 3-1-002 (A), 25 Jan 67.)

k. If a field test is to be performed, check with the responsible frequency management agency to ensure authorization for radiation in the required frequency bands during the anticipated test period.

4. TEST CONTROLS

a. Organize test team and establish responsibilities for test conduct reporting, and data control.

b. Check to ensure that test equipment and accessories are available, operational, and meet certified calibration requirements.

c. Perform an operational check of the test item(s) to ensure normal, correct functioning.

d. Prepare adequate safety precautions to provide safety for personnel and equipment and ensure all safety SOPs are observed throughout the test.

5. PERFORMANCE TESTS

NOTES: Because of state-of-the-art advances incorporated in new equipment, these procedures may be modified when required by the design or characteristics of the test item. Such modification shall not affect the validity of the test results. Conduct VSWR and Gain measurements of each communication antenna prior to System Tests.

5.1 System Tests

5.1.1 Antenna Pattern Test

a. Place the basic landing control central on the turntable of the antenna pattern measurement facility with the Ground Control Approach (GCA) radar and other items not integral to the basic central located at the same distance they would be in a tactical situation.

b. Make a 360° antenna pattern at 0°, 15°, 30°, 45°, and 60° elevations for each antenna.

c. Conduct RF coupling measurements between each communication transmitter antenna and each additional communication antenna mounted as a part of the Ground Control Station.

5.1.2 Communication Range Test

a. Use an aircraft with an appropriate complement of radios to match the Landing Control Central in this test. Check all radios for proper operation prior to each flight.

b. Install appropriate recorders (voice and data as applicable) in the Landing Control Central and check for proper operation to include range timing clock signals.

c. Install a beacon, if required for radar tracking and space plotting, in the aircraft and check it.

d. Locate the complete Landing Control Central with GCA or other radar facing the direction of the 100 to 150 mile (160.93 to 241.39 km) flight path. Note the direction of this flight path relative to the Control Central and the antenna patterns made in paragraph 5.1.1.

e. Fly the test aircraft, with the radar tracking and plotting and all other equipment and instrumentation operational, outbound on the flight path at a nominal 2000 feet (609.61 m) above terrain or other selected altitude.

f. Establish two-way communications on each radio and antenna at 5-mile (8.05 km) intervals until contact is lost on all radios. Note the range at which each radio contact is lost.

g. Reverse the aircraft course and proceed inbound until communication is re-established with each radio when the final radio contact is lost. Note the range at which communication is re-established on each radio.

h. Turn the aircraft around and return at 150 miles, unless instructed otherwise, if radio contact is not lost within the 150-mile outbound flight.

i. Repeat the flights until all radios have been tested if all radios and antennas cannot be tested on one flight.

5.1.3 Radar and IFF Acquisition Range

a. All equipment and instrumentation shall be the same as in paragraph 5.1.2 except:

(1) Equip the aircraft with an operational IFF.

(2) Record the radar scope data digitally or by video or photographic cameras.

b. If the Landing Control Central has a search or surveillance radar and a GCA precision landing radar capability associated with it, both should be operational during this test and vectoring and control transferred at appropriate ranges.

c. Cross the aircraft over the Landing Control Central at 1000 feet (304.8 m) on an outbound flight path with all equipment and instrumentation operational.

d. Pick up the aircraft with the GCA precision landing system, vector it to a simulated runway center line, and increase its altitude to 2000 feet (609.61 m) at 5 miles (8.05 km) and proceed on its flight path.

e. Track the aircraft with each radar on its outbound leg and interrogate the IFF at 5-mile (8.05 km) intervals.

f. Continue the aircraft on the outbound flight until it can no longer be tracked by any of the control central radars or respond to an IFF interrogation.

g. Reverse the aircraft's course and fly an inbound flight path when informed of this loss of contact or at 100-mile (160.93 km) range.

h. Vector the aircraft for a simulated GCA landing and IFF interrogated at 5-mile (8.05 km) intervals when it is picked up by the radars on its inbound flight.

i. Control the aircraft with the GCA on a simulated landing to an altitude of 500 feet (152.4 m) and then release it.

j. The above tests may be repeated at different altitudes if desired.

5.2 Data Required.

5.2.1 Antenna Pattern Tests.

a. Generate polar antenna pattern plots for each antenna at elevations of 0°, 15°, 30°, 45°, and 60°. Annotate these plots to identify antenna, antenna location, and RF frequency.

b. A drawing showing the position of the Landing Control Central on the turntable relative to 0° azimuth on the plot, the location of other equipment associated with the Landing Control Central and the location of each antenna.

5.2.2 Communication Range Test.

a. Make a scaled range plot with altitude and time annotations of the outbound and inbound flight paths of the aircraft for each test flight.

b. Make a tabular listing for each flight and each radio indicating:

(1) Aircraft range and altitude, and time when communication was lost.

(2) Aircraft range and altitude, and time communications were reestablished.

(3) Frequency of the radio.

c. Make scaled drawing of the test site showing the location and angular position of each equipment relative to the center line of the flight path.

d. Produce tapes from the airborne and ground recorders.

5.2.3 Radar and IFF Acquisition Range

a. Make scaled range plot with altitude and time annotation of the outbound and inbound flight paths of each test flight.

b. Make a scaled drawing of the test site and all equipment with the simulated runway center line indicated.

c. Make a tabular listing for each flight indicating:

(1) Aircraft range and altitude, and time when contact was lost by radars and IFF.

(2) Aircraft range and altitude, and time when contact was re-established by radars and IFF.

(3) Time and position data when aircraft was vectored for simulated GCA landing, when simulated landing control started, and when aircraft was released at 500 feet (152.4 m).

(4) Tapes from both airborne and ground recorders.

(5) Radar scope data.

6. DATA REDUCTION AND PRESENTATION

6.1 General

Processing of raw test data in general includes, but is not limited to, the following steps:

a. Marking test data for identification and correlation according to subtest.

b. Organizing data into tabular and graphical form.

c. Determining the statistical variation of the results in terms of average value and standard deviation of the particular quantities and the correlation among two or more quantities.

NOTE: The test directive (or specification) serves to define the types and characteristics of the raw test data and the ultimate objective defines the form of the test data desired.

6.2 Antenna Pattern Test

Evaluate the antenna pattern data for any deviation from a normal pattern for the type antenna. If such deviations are noted, present a logical explanation with supporting data.

6.3 Communication Range Test

a. Make flight path plots, tabular data, and airborne and control central tape recordings, and compare them. Resolve any differences in communication range data.

b. Evaluate the range data on loss of communication and re-establishment of communication for each radio and antenna for each flight with respect to the antenna pattern at that azimuth and the theoretical normal range over the type terrain. Present appropriate data in graphic and/or tabular form to support the evaluation.

c. The range at other azimuths can be calculated by:

(1) Putting the measured range and antenna gain plus other data from the antenna pattern into the appropriate air-ground mathematical formula used by the Electromagnetic Environmental Test Facility and solving for transmitter power.

(2) Substituting the antenna gain from the antenna pattern at the other azimuth in the formula and solving for the communication range. This would be the communication range at the azimuth for the same terrain and field conditions as the measured range. (Field measurement of the communication ranges at other azimuth headings would not only be time-consuming and costly, but could also result in noncomparative range data because of the different terrain conditions on each azimuth flight headings.)

6.4 Radar and IFF Acquisition Range

Evaluate the test data and data presented in graphic and/or tabular form to support the following.

a. The radar(s) contact ranges on both outbound and inbound test flights.

b. The IFF contact ranges on both outbound and inbound test flights.

c. The accuracy of the vectoring and position control (both azimuth and elevation) of the radar(s) with respect to the simulated runway center line on both outbound and inbound test flights.

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APPENDIX A

CHECKLISTS

A.1 Pretest

a. Detailed test procedure available _____

b. Instrument support facility available _____

c. Engineering logbook available _____

d. Safety precautions instituted _____

e. Test personnel informed of review rights _____

f. Sample plan available _____

A.2 Test Conduct

Detailed test procedure available _____

A.2.1 Antenna Pattern Test

a. Test setups inspected _____

b. Measurements completed, data recorded _____

A.2.2 Communication Range Test

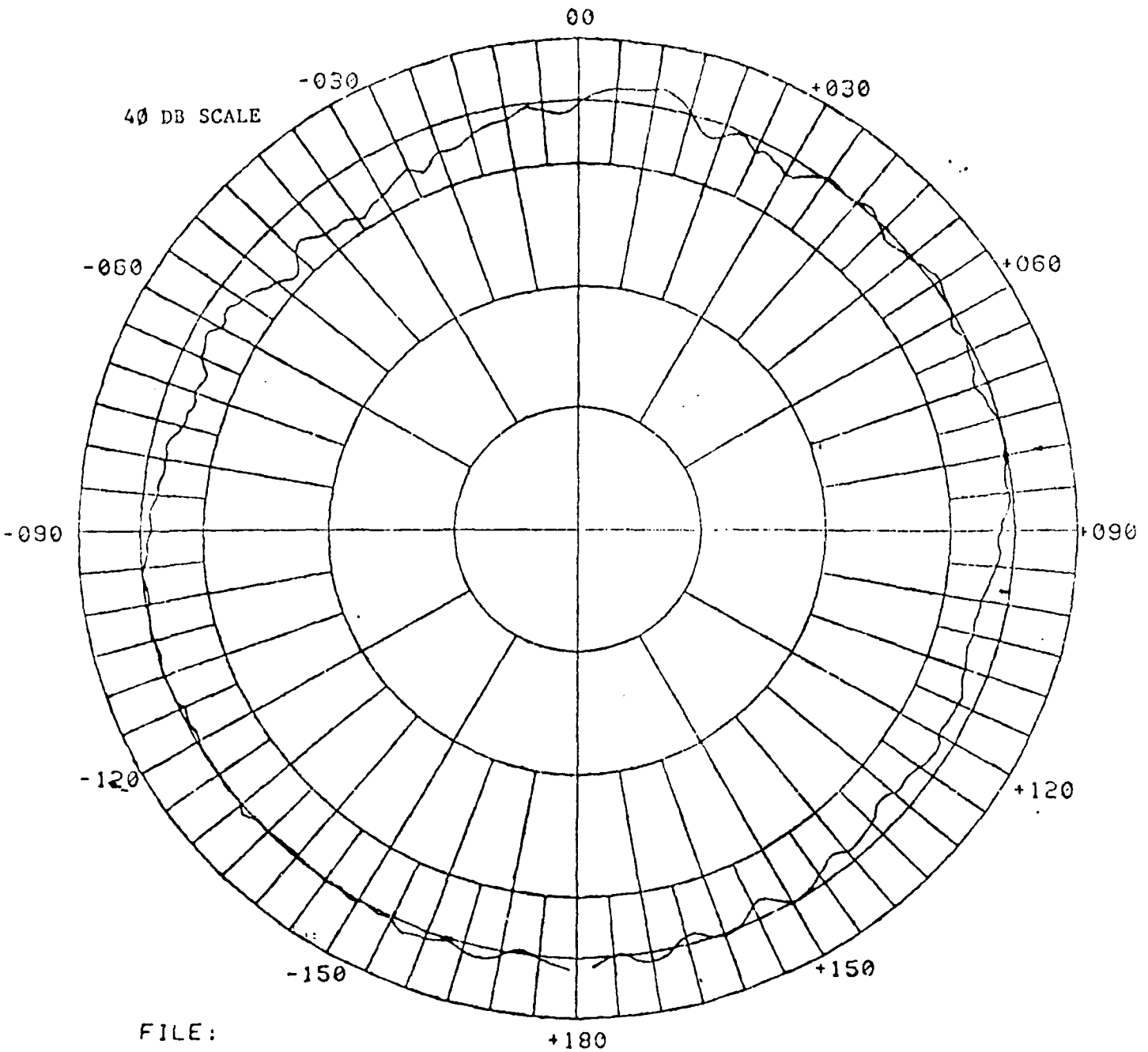
a. Test setups inspected _____

b. Measurements made, data recorded _____

A.2.3 Radar and IFF Acquisition Tests

a. Test setups inspected _____

b. Measurements made, data recorded _____



FILE:

SCAN NR: STEP ANGLE: PLOT_____ AA

FREQ NR: FREQ(MHZ):

CONFIGURATION

APPENDIX B

DATA COLLECTION SHEETS

B.1 Antenna Pattern Test

(Insert Polar Pattern Sheet)

B.2 Communications Range Test

Type Aircraft _____ Flight No. _____

Weather _____

Test Conductor: _____ Date _____

TYPE RADIO	ANTENNA	FREQUENCY	OUTBOUND RANGE	OUTBOUND ALTITUDE	OUTBOUND TIME	INBOUND RANGE	INBOUND ALTITUDE	INBOUND TIME

B.3 Radar Range Acquisition Test

Type Aircraft _____ Type Radar _____

Flight No. _____ Weather _____

Test Conductor _____ Date _____

	RANGE	ALTITUDE	TIME	COMMENTS
Aircraft at 2000 FT				
Contact Host (Outbound)				
Contact Made (Inbound)				
Vectored to Precision Landing Control				
Landing Control Initiated				
Aircraft Released From Control				

B.4 IFF Range Acquisition Test

Type Aicraft _____ Type IFF _____

Flight No. _____ Weather _____

Test Conductor _____ Date _____

	RANGE	ALTITUDE	TIME	COMMENTS
Contact Lost Outbound				
Contact Made Inbound				

APPENDIX C

REFERENCES

1. TECOM Pam 310-4 — Index of Test Operations Procedures
2. TECOM Supplement 1 w/change 1, to AMC Reg 310-6 — Quality Assurance Publication
3. TECOM Pam 70-3 — Project Engineers' Handbook
4. TECOM Reg 70-24 — Documenting TECOM testing
5. TOP 3-1-002 (A) — Confidence Intervals and Sample Size 25 Jan 67, AD No. 718229

APPENDIX D

ABBREVIATIONS

MIL STD	Military Standard
GCA	Ground Control Approach
GCS	Ground Control Station
IFF	Identification Friend or Foe
RF	Radio Frequency
SOP	Standard Operating Procedure
TOP	Test Operations Procedure
VSWR	Variable Standing Wave Ratio

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